

# PATENT ABSTRACTS OF JAPAN

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## (54) STENT HARDLY CAUSING RESTINOSIS

### (57)Abstract:

PROBLEM TO BE SOLVED: To provide an intravascular indwelling type stent hardly causing restinosis.

SOLUTION: Stereoscopic micropatterns with 0.02-20  $\mu\text{m}$  of repeated pitch are formed at least on the surface of the inside wall of this stent. The stent with the stereoscopically micropatternized surface is used to significantly accelerate migration, fixation, and growth of intravascular endothermal cells on the inside surface of the stent after angioplasty. As a result, it is enabled to significantly reduce a probability of restinosis of the artery undergone angioplasty.

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CLAIMS

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[Claim(s)]

[Claim 1]

Stent characterized by forming the solid micro pattern with a repeat pitch of 0.02-20 micrometers in a wall front face at least.

[Claim 2]

Stent according to claim 1 to which said solid micro pattern is characterized by being formed of the irregularity of a stent wall front face.

[Claim 3]

Stent according to claim 1 characterized by forming said solid micro pattern from the cellular adhesiveness matter applied or combined on a stent wall front face.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

##### [Field of the Invention]

This invention relates to the stent with which it deals for the purpose of the escape of damage, a constriction, the blockaded blood vessel, and a therapy. This invention relates to the restenosis and the stent with few possibilities of causing re-lock out, by the detention part in more detail.

#### [0002]

##### [Background of the Invention]

As cures, such as heart coronary occlusion which is the key factor of myocardial infarction, an angioplasty method attracts attention and a majority of the examples of a formula are reported. This approach is mainly based on the angioplasty by reservation and laser excision of the blood vessel passage by balloon escape, and many good treatment results are shown. It is reported by on the other hand that the restenosis of the blood vessel after treatment and re-lock out occur at 40 - 50% of high rate, and it is pointed out as a big trouble of the \*\*\*\* method. The physical damage produced on the occasion of opening of the lock out artery by the angioplasty serves as a trigger, and the cause which causes the restenosis and re-lock out is presumed to be that the plaque of a cell and the local hyperplasia of a tube wall occur. Although administration, balloon catheter insertion and an escape for the second time, or laser treatment of drugs etc. was tried to the restenosis etc., it was what can say easily that neither has shown the fundamental solution, and forces a big pain and a burden upon a patient.

#### [0003]

The restenosis is caused as mentioned above by the vital reaction to the physical damage on the blood vessel by the angioplasty method, or is based on contraction of an artery wall proper. Many attempts which it is going to solve by using the stent of a detention mold for the interior of a blood vessel are reported to the physical problem of the restenosis and re-lock out. Such stent tends to prevent contraction of a blood vessel while patching up an incision part, and it tends to decrease the incidence rate of an artery obstruction patient's restenosis intentionally.

#### [0004]

The stent for blood vessels is the small member medical device of the shape of tubing which consists of a metallic material or polymeric materials. The example of treatment of the typical lock out blood vessel using this is illustrated hereafter. The stent for blood vessels is detained in vascular occlusion circles via the balloon catheter inserted in a blood vessel lumen.

Subsequently, by expanding balloon, the path of this catheter or this stent is made to expand irreversible, or self-extending of the stent is carried out by some approaches, such as magnetic-induction method heating after detaining in arterial blood tubing, and it secures patent [ of a blood vessel ]. Thus, it is going to maintain a good blood flow over a long period of time.

#### [0005]

The example of treatment of the above-mentioned approach of using the stent also increases in recent years, and it has left good treatment results. However, it is hard to say that it was still completely solved about problems, such as re-lock out, and it is said that the restenosis and re-lock out occur at 20 - 30% of a rate. if the restenosis and re-lock out occur by the stent part

once inserted in the blood vessel lumen, compared with the first time, the treatment will be boiled markedly and will serve as a difficult thing. That is, re-lock out of the patient who could not remove substantially the stent which caused the situation of re-lock out from Homo sapiens arterial blood tubing, and dealt with the stent for this reason caused the very critical symptom, and it was pressed for it by the need of finally taking the conventional surgical procedures, such as a by-pass operation.

[0006]

Various invention and a design are made by the ingredient of the stent, the configuration, and the way method until now for the purpose of the therapy of arterial blood tubing obstruction including the therapy of coronary occlusion. However, if it is in the way method from the former, and an ingredient, the risk of the above-mentioned restenosis and re-lock out cannot be bypassed, but it has become \*\*\*\* of application of the angioplasty for which just this serious trouble uses the stent. Therefore, the restenosis and the stent with little fear of re-lock out were strongly demanded from the medical site.

[0007]

By the way, in one aspect, a thrombus, the restenosis by the blood vessel organization, and re-lock out make a part of vital reaction to damage on a blood vessel wall, and can say it also as the product of the recovery process by angiogenesis. The hyperplasy of formation of the thrombus which is a kind of foreign body reaction to an insert, the migration of a vascular endothelial cell or a smooth muscle cell, fixing, growth, and intima is contained in such a recovery process, and the biological response of these various kinds becomes the factor to which re-lock out of arterial blood tubing is urged.

[0008]

In order to cope with a restenosis problem using the physiological function and singularity of a blood vessel wall cell, the technique of inserting the stent with an endothelial cell is proposed. The stent which carried out seeding culture of the increased Homo sapiens endothelial cell to up to the stent, and was covered with the endothelial cell is produced, it inserts in a vascular injury part, and it is supposed that the fixed result is mentioned to generating prevention of re-lock out. However, this approach has be [ much constraint / and ] problems also in operations, such as a problem of LIFE of an endothelial cell, and sterility-treatment, also in cost, when an advanced technique is needed for growth of an endothelial cell, seeding to the stent, and covering, and it is hard to say that it is not necessarily practical.

[0009]

This invention is completed by examining the above-mentioned trouble wholeheartedly in view of such a situation. The base material which carried out the coat of the living body origin matter, such as a collagen, fibronectin, and vitronectin, as a substrate which it pastes [ substrate ] up suitably and proliferates a vascular endothelial cell is known. Moreover, the patternizing ingredient by lithography is charming interest in recent years as an ingredient which can control adhesion of a cell, growth, and differentiation behavior intentionally variously. this invention persons were applying a micro patternizing technique to the surface treatment of the stent, migration of a vascular endothelial cell, fixing, and growth were performed quickly, and this invention was completed for generating of re-lock out in the disease part of arterial blood tubing being controlled intentionally based on a header and this after stent insertion.

[0010]

[Objects of the Invention]

This invention aims at the restenosis of the blood vessel after stent insertion (or tubular organ) and the incidence rate of re-lock out offering the low stent. Moreover, it aims at offering the approach of preventing the restenosis which originates in the stent detained in the tubular organ, and is generated.

[0011]

[Summary of the Invention]

This invention is stent characterized by coming to form a solid micro pattern with a repeat pitch of 0.02-20 micrometers in a wall front face at least.

Said solid micro pattern of the stent concerning this invention is characterized by being formed

of the irregularity of a stent wall front face.

[0012]

Or said solid micro pattern is characterized by being formed from the cellular adhesiveness matter applied or combined on a wall front face.

Said solid micro pattern is characterized by forming the shape of the shape of the shape of the shape of a honeycomb, and a grid, and a dot, and a square, and a rectangle, and a hexagon, and a triangle, and the minute configuration of either of the lines continuously repeatedly.

[0013]

The stent which makes this front face come to fix the solid micro patternizing film whose thickness is 0.05–100 micrometers is desirable.

There is stent for blood vessels as a suitable mode of said stent.

[0014]

[Detailed Description of the Invention]

This invention is stent characterized by coming to form the solid micro pattern of a fixed repeat pitch in a wall front face at least. If the solid micro pattern which makes such a fixed repeat pitch is formed in the stent front face, the migration of the vascular endothelial cell to the front face, fixing, and growth will be promoted, and the restenosis and lock out accompanying stent wearing will be controlled as a result. By applying a micro patternizing technique for the surface state of the conventional stent, this invention is reformed so that the cell affinity reproductive function may be demonstrated, and it makes it possible to control re-lock out effectively.

[0015]

In addition, in this specification, a “solid micro pattern” means the pattern constituted by the repeat of a large number by the group by which much minute three-dimensional structures have been arranged at the fixed configuration.

Hereafter, this invention is explained to a detail in order of the function of the stent of the stent, the shape of its surface type, and this invention.

<Stent>

As long as it removes performing surface treatment processing described below about the structure of the stent concerning this invention, the stent of what kind of design is sufficient as a matter of fact. This means that the above-mentioned restenosis and generating of re-lock out can be further prevented beforehand by this invention, holding the description and function of various stent.

[0016]

Stent may be the thing from which a configuration does not change before and after inserting into a blood vessel or a balun escape mold, self-extending, and its combination. Although the example of the stent which is attached to a PTCA (endemic coronary-arteries plasty) catheter, and is inserted, or the stent detained in the blood vessel affected part by expansion of a balloon catheter is indicated by U.S. Pat. No. 4,733,665 (Palmaz), U.S. Pat. No. 4,886,062 (Wiktor), etc., this invention is applicable also to the stent by these advanced technology.

[0017]

If the stent concerning this invention is an ingredient which has the physical description which can perform the design, it can use any ingredients suitably. Generally the polymeric materials of the biodegradability of polymeric materials, such as metallic materials, such as stainless steel and titanium, PET, and polyethylene, polylactic acid, etc. are mentioned in ingredient.

The following ingredients can be illustrated if it explains in full detail more.

[0018]

Specifically, the stainless steel currently used from the former as a metallic material, a tantalum, titanium, a tungsten, platinum, these alloys, etc. can be illustrated.

When using materials other than a metal, what has possible repeating the configuration of detailed irregularity which suits the purpose of this invention so that it may mention later, and preparing in a front face as a pattern is desirable. As polymeric materials which suit this demand, PET (polyethylene terephthalate), PBT (polybutylene terephthalate), a polycarbonate, polyethylene, polypropylene, polyacetal, polystyrene, polyacrylic ester, etc. can be illustrated.

[0019]

As a biodegradable polymer, polyamide systems, such as polyhydroxy ester systems, such as polylactic acid, polyglycolic acid, the Pori malic acids, and those copolymers, and the poly caprolactone, can be illustrated. A collagen, agarose, gelatin, a chitin, chitosan, etc. are desirable as living body origin matter.

About the ingredient which constitutes the stent, although you may be any of a metallic material, polymeric materials, or the polymeric materials of biodegradability as mentioned above, the stent of a publication can also be preferably used for U.S. Pat. No. 4,733,665 (Palmaz) and U.S. Pat. No. 4,886,062 (Wiktor).

[0020]

If it is in the shape of the structure of having the shape of tubed and a bellows, and a crookedness part, and a mesh, the shape of a wire, and a fibrous ingredient, as a solid-state moldings as a configuration of the stent, you may have the shape of the shape of textiles, and a nonwoven fabric, and if a problem does not arise about the physical damage nature to the reinforcement after the detention in a blood vessel, and a blood vessel wall fundamentally, the thing of various configurations can be used.

The stent is inserted, conveyed and detained in the blood vessel affected part in the form inserted at the tip of a catheter on the occasion of detention. From the need of minimizing the physical damage at the time of conveyance in a blood vessel, the stent of the type which carries out a balun escape at the time of detention or which carries out self-extending is used suitably. Moreover, the combination of self-extending and a balun escape may perform.

<The configuration on the front face of the stent>

It is concerned not only with the recovery process as opposed to [ in a wrap endothelial cell ] damage on a blood vessel wall for the innermost layer of blood vessel intima but with the so-called vascularization, and all take the process in which shift of biogenic substances, such as protein to a damage part and a macrophage, migration, and fixing occur, and the migration of a smooth muscle cell and an endothelial cell, fixing, and growth subsequently take place. It is important for evasion which will be the main factor of the restenosis and re-lock out if it takes notice of the behavior of such an endothelial cell from a living body's foreign matter recognition ability to the stent migration and for it to be established and to proliferate a stent front face in the comparatively early phase after dealing with a vascular endothelial cell. For the purpose to which inner-bark-ization on this quick front face of the stent is urged, this invention persons found out that it was very important that at least jointing of an endothelial cell is the front face by which solid micro patternizing was carried out. Therefore, any ingredients are usable if the ingredient of the stent part where a vascular endothelial cell is established does not show the toxicity and fixing inhibition nature to a cell, and growth inhibition.

[0021]

In research of this invention, it became clear that the configuration of a solid micro patternizing front face and voidage were important factors for the migration of a vascular endothelial cell, fixing, and growth. It is important for a solid micro patternizing configuration that the minute pattern is formed continuously repeatedly. The configuration can take the shape of the shape of the shape of the shape of the shape of a honeycomb, and a grid, and a dot, and a square, and a rectangle, and a hexagon, and a triangle, a line, etc. 0.02-20 micrometers (micrometer) of repeat pitches of the pattern are 0.05-10 micrometers preferably. When a pitch is thinner than 0.02 micrometers, a difference with the bulk material by which solid micro patternizing is not carried out is lost substantially, and the effectiveness of this invention is not accepted. Moreover, when larger than 20 micrometers, it becomes the size of a cell, and a solid micro pattern more than an EQC, and a desirable result is not given for fixing of a cell.

[0022]

As long as it fulfills conditions, such as the above-mentioned pitch and voidage, a micro patternizing front face is the thing of the quality of the material to which for example, what [ not only ] is not necessarily formed of surface micro-processing processing but the stent front face equips the proper with such a pattern, and may be constituted. If an example is given, it will be a solid micro patternizing front face by the textile of textile fabrics or a nonwoven fabric etc.

[0023]

Moreover, if the cost of surface processing processing etc. is taken into consideration, the thing of the repeat of the configuration usually same as the whole micro patternizing front face is suitable. However, you may not be the pattern of the same configuration which continues in a fixed pitch, but may be the repeat pattern of the combination of two or more configurations. It is thought appropriate for selection of such a micro patternizing configuration to ponder the effectiveness of inner-bark-izing in which it occurs after equipping in a blood vessel, or the effectiveness of re-lock out suppression and the cost of processing processing.

[0024]

The thickness of a solid micro patternizing film is 0.1–20 micrometers, preferably, when thinner than 0.05 micrometers, in order that an endothelial cell may not recognize a pattern, it does not have 0.05–100 micrometers of effectiveness, and when thicker than 100 micrometers, a crevice is superfluously deep and noneconomic.

It may face manufacturing the stent which has the front face by which solid micro patternizing was carried out, and a solid micro pattern may be made to form in a stent front face directly. The approach which produces a solid micro patternizing film separately instead, and a stent front face is made to fix after that can also be used suitably. When an ingredient is a metallic material, since especially this solid micro patternizing film makes good the adhesive property on the front face of the stent, various polymeric materials can be used for it.

[0025]

If the polymeric materials used for adhesive amelioration are illustrated, Polylactic acid, polyglycolic acid, the Pori malic acids, those copolymers, the poly caprolactone, polyhydroxy butyrate, poly FOSUFO ester, a fibrin, a cellulose, starch, a collagen, polyurethane, polyester, polyolefine, a polyisobutylene, polyvinyl chloride, polyisoprene, polybutadiene, a polyisobutylene, a styrene butadiene block copolymer (SBS), a styrene isoprene block copolymer (SIS), the hydrogenation object of SBS and SIS, Nylon 66, polyimide, etc. can be mentioned. If it has substantially the adhesive property of a solid micro patternizing film, a metallic material, etc., even if it will be which ingredient, it can be used suitable for the stent of this invention.

[0026]

After immersing a stent body in a polymeric-materials solution, after the polymeric materials for these adhesion remove a solvent or carry out the spray of the polymer solution to the stent, they can take the approach of removing a solvent after spreading thru/or a spray, and pasting up and fixing a polymer solution at a stent top on one side of the method of removing a solvent, or a solid micro patternizing film.

[0027]

Surface functionalization by solid micro patternizing processing of the stent can be given to all on the inside of the stent, and external surface. But only by the solid micro pattern processing by the stent inside which is the blood contact surface, sufficient engine performance is obtained about grant of anti-thrombus nature, and reduction of re-lock out of arterial blood tubing in many cases.

Various surface ultra-fine processing technology can be applied to the solid micro patternizing on the front face of a stent body, and production of a solid micro patternizing film, and it is not especially limited to them. For example, when forming a solid micro patternizing front face with the irregularity on the front face of the stent, the technique of self-organizing of photolithography or a cast solution can be used. Or the solid micro patternizing front face by applying or combining the cellular adhesiveness matter with a front face is producible by the micro contact printing method.

The photolithography method

A photoreaction nature macromolecule is applied on a base and it exposes using the photo mask which has the solid micro pattern made into the purpose. Subsequently, washing removal of the unexposed part is carried out, and the film of the photoreaction nature macromolecule which carried out solid micro patternizing is obtained. According to a conventional method, the collagen and fibronectin which are a cellular adhesiveness macromolecule or a factor, vitronectin, a laminin, etc. are fixed to the side-chain active group of a photoreaction nature macromolecule,

and a solid micro patternizing film is obtained.

[0028]

As an approach of forming a solid micro pattern in a metal stent front face, how to use for example, the plating film can be considered. To the stent inner skin made from stainless steel which serves as a stent raw material as an example, film, such as about 30–100-micrometer nickel–titanium film, is formed by vacuum evaporation or the sputtering method. Next, after coating the front face of such nickel–titanium film with a sensitization bridge formation mold resist, using the micro pattern original edition created beforehand as a photo mask, it exposes with a contraction projection aligner and the micro pattern of the original edition is imprinted to a resist. Elution of the part of a resist non-constructed a bridge is carried out by the after that usual approach, the above-mentioned micro pattern is created on a resist, and etching removes unnecessary metal parts, such as nickel–titanium film.

[0029]

In addition, the nickel–titanium film of a predetermined micro pattern may be formed in a stainless steel front face by the sputtering method, without etching the nickel–titanium film.

The micro patterning method by self-organizing

The cast of the polymer solutions, such as an amphiphilic giant molecule, the poly ion complex, polystyrene (polystyrene sulfonate / cationic lipid), polylactic acid, and PMMA, is carried out on a glass substrate thru/or a high polymer film, and a solvent is gradually evaporated under a saturated steam ambient atmosphere. The self-organizing film which has honeycomb structure by this and by which solid micro patternizing was carried out is obtained. It exfoliated from the substrate, this film was fixed to the stent body inside, and the solid micro patternizing stent was obtained. Moreover, the solid micro patternizing film can adjust the pattern configuration and size to arbitration by carrying out biaxial stretching one shaft according to a demand.

[0030]

As another mode of the stent of this invention which gave the solid micro pattern to the front face, said solid micro pattern may be formed with the cellular adhesiveness matter applied or combined on a stent front face. A collagen, fibronectin, vitronectin, a laminin, etc. are illustrated as cell-adhesion material.

When applying or combining cell-adhesion material with a stent front face and forming a solid micro patternizing front face, the following micro contact printing can be used.

The micro contact printing method (the approach of Whitesides)

The coat of the photoresist mask is carried out on a silicon wafer, and the stamp of a poly dimethylsiloxane elastomer is produced on the master of the solid micro pattern obtained after exposure. Subsequently, alkane thiol ink is put on this stamp, on the stent which carried out surface treatment with gold thru/or silver beforehand, or a high polymer film, a stamp is carried out and a monomolecular film is formed in the shape of a pattern. Otherwise as ink, silane coupling agents, such as alkyl trichlorosilane and alkyl triethoxysilane, are usable. the alkyl end of ink -- oligo ethylene with high compatibility with protein -- Io -- by combining KISHIDO, the oligopeptide of cellular adhesiveness, etc., the migration of a vascular endothelial cell, fixing, and growth can be promoted intentionally.

[0031]

Or the approach which produces separately the solid micro patternizing film which carried out the coat of the cellular adhesiveness matter concerned as mentioned above, and a stent front face is made to fix after that can also be used. Thus, even if it is the solid micro pattern formed with the cellular adhesiveness matter applied or combined on the stent front face, the repeat pitch, the continuation pattern configuration of a repeat, etc. are as above-mentioned.

Other surface micro-processing processing techniques

The formation technique of the functional front face described previously is illustrated as the suitable stent surface treatment approach for manufacturing the stent of this invention. Other techniques can also be used unless the meaning and effectiveness of this invention are spoiled. For example, the approach of carrying out the exhumation of the ingredient front face to a fixed configuration on submicron level with an excimer laser, the laser ablation technique combined with the surface chemistry reaction, drilling, the solid ultra-fine processing technology by



lamination, etc. are mentioned.

<The function of the stent of this invention>

The approaches by this invention are restenosis, such as a blood vessel which originates in the stent detained in the tubular organ, and is generated, and a method of preventing re-lock out effectively. This becomes possible at least by forming a solid micro pattern with a repeat pitch of 0.02-20 micrometers in the wall front face of the stent.

[0032]

By using the stent which has the front face which performed the above-mentioned solid micro patternizing processing, the migration of a vascular endothelial cell, fixing, and growth are intentionally promoted by the stent inside after the operation [ angiogenesis ]. Consequently, it becomes possible to reduce intentionally the probability of occurrence of the restenosis resulting from the stent detained in arterial blood tubing which gave the angioplasty, and re-lock out.

The above-mentioned operation mechanism by the stent of this invention is further explained to a detail.

[0033]

It is shown clearly that a vascular endothelial cell demonstrates various functions, such as production secretion of constant maintenance of not only the role that covers the innermost layer of a blood vessel wall but a blood vessel and blood flows, such as an anti-thrombus and restoration, the vascularization, various factors, and the pacemaker. Neither the vascularization nor playback can break out without growth and migration of such an endothelial cell. It is said that further various kinds of arteriosclerosis nature diseases stem from the functional disorder of a vascular endothelial cell. this invention person has recognized the pattern on the front face of a body where the solid micro patternizing of such growth and the vascular endothelial cell which carries out migration was carried out during research of this invention, and noted that there was an inclination established and increased. When the three-dimensional continuation detailed pattern was given to the stent front face, what is urged to fixing to the stent of an endothelial cell was found out. Although this phenomenon may have the habit and relation of being easy to carry out orientation of the endothelial cell to a flow direction, for the moment, it does not come out of the region of imagination.

[0034]

It increases and the endothelial cell fixed to the stent front face by which solid micro patternizing was carried out [ above-mentioned ] covers a stent inside with a monolayer. If such inner-bark-ization takes place, so to speak, a blood vessel wall and a false condition will be quickly formed in a stent inside. If it becomes so, this stent cannot be easily set as the object of a foreign matter recognition operation of a living body, and it will be considered that immunity and a foreign matter exclusion function stop operating. That is, the migration to the monocyte and the stent placement part of a macrophage which lead to an inflammatory response is also hard to be caused.

[0035]

If inner-bark-ization rapid as mentioned above occurs in the inside of the detention stent, as for the situation which carries out a plague, the mechanical stimulus by the stent detained in the blood vessel and an abrasion will be avoided for the cell (fibroblast, smooth muscle cell) of a blood vessel wall by the basis. As a result, it is hard coming to generate inflammation, superfluous hyperplasy, etc. leading to the restenosis. Therefore, the restenosis of arterial blood tubing which gave the angioplasty, and the probability of occurrence of re-lock out may be reduced intentionally.

[0036]

The solid micro patternizing stent by this invention can be used as effective also in the angioplasty of arterial blood tubing obstruction, such as a renal artery, as each part of Homo sapiens besides the coronary occlusion of the heart.

The stent of this invention which has a solid micro patternizing front face is restenosis, such as a blood vessel, and stent which can prevent lock out effectively. Although application of the stent of this invention has so far been explained focusing on the failure in a blood vessel, applying to other tubular organs is not eliminated. If the above-mentioned operation mechanism

in the stent of this invention is recollected, such stent has possibility of being applied to all the aspects of affairs aiming at the restenosis of vessels (a blood vessel, a lymphatic duct, a bile duct, a ureter, trachea, etc.), and prevention of re-lock out. This will be obvious from not asking the stent of what kind of structure, a gestalt, the quality of the material, size, or a mode, as long as the stent of this invention has the description which the shape of the surface type mentioned above. Various application of this invention and application are easy for this contractor.

[0037]

It extends similarly to the case where the migration of the cell in connection with the detection and the reaction, or damage section restoration by the cell which answers mechanical stimulus, fixing, and growth specifically involve, and can apply. For example, when promoting fixing of a migration sexual cell besides all endothelial cells and an inner-bark precursor cell, it is not only the inside of a blood vessel but a tubular organ etc. further.

Since it comes to form the solid micro pattern of a fixed repeat pitch in a wall front face at least, as long as the stent of this invention is required, it may limit the micro patternizing only to the wall. It is because quick inner-bark-ization of a stent wall serves as a key substantially at the restenosis and the purpose which prevents re-lock out. It can also consider as a functional front face different from a wall by giving other functions to the stent outer wall maintained by the lumen wall at a contact condition in that case. For example, it is also possible to roll a high polymer film for drug sending out which was proposed by JP,8-224297,A or JP,8-33718,A about the skin, or to coat a polymer. If the anti-growth drugs which prevent the restenosis, antithrombotic drugs, or an abrasion remedy agent is used as a drug, the effectiveness of this invention which inhibits intima hyperplasy and thrombosis will become a much more positive thing.

[0038]

In order to consider as a histocompatible stent skin, insertion of the balloon tip catheter and wearing of the stent may be performed smoothly, and the coating film for increasing further the coating film which consists of hydrophilic lubrication polymeric materials so that the blemish of scratch nature may not be produced, or biocompatibility may be covered. Or the roentgenopaque material which is excellent in imaging nature may be used.

[0039]

[Effect of the Invention]

When a measure is taken in a blood vessel etc., the stent which has a solid micro patternizing front face by this invention can control effectively restenosis, such as a blood vessel in a detention part, and re-lock out, so that clearly also from the above explanation.

[0040]

[Example]

The following examples are type examples of this invention, and it does not only mean explaining this invention more concretely moreover, and checks that the range of this invention is not limited to an example.

[0041]

[Example 1]

The methylene chloride solution (1.0g/L) of the poly caprolactone (molecular weight 130,000) and the toluene solution (0.7 g/L) of an amphiphilic giant molecule (N-carboxy alkyl / alkyl denaturation object of polyacrylamide) were mixed at a rate of 1:2, and the cast was carried out on the glass substrate. This glass substrate was put under a room temperature and conditions of 85% of humidity, and the structure which has honeycomb structure by carrying out evaporation removal of the solvent gradually was obtained. This solid micro patternizing film can be exfoliated holding that pattern configuration from on a glass substrate.

[0042]

It was immersed in the methylene chloride solution (10 g/L) of polylactic acid / polyglycolic acid copolymer (molecular weight 4,000), the stent made from balloon escape mold stainless steel fabricated by the mesh configuration with laser was \*\*\*\*(ed) within the draft, and the coat of the stent front face was carried out with this copolymer. The above-mentioned solid micro patternizing film was stuck to the inside of this stent that carried out the surface coat by

pressure, and, subsequently the solid micro patternizing film was pasted up on the inside by cooling after warming at 65 degrees C.

[0043]

The balloon catheter was used and the stent made from solid micro patternizing stainless steel of the balloon escape mold obtained by the above-mentioned process was detained in arterial blood tubing of a laboratory animal. On the other hand, except for the point which does not form the micro pattern in a front face, the group which detained the stent completely of the same type was made into the control group. In the case of the stent of this example, the inflammation of a blood vessel wall and superfluous hyperplasia were not accepted, but controlled the restenosis of a blood vessel, and re-lock out intentionally as compared with the control group.

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[Translation done.]